UNITED STATES DISTRICT COURT
DISTRICT OF MINNESOTA

In Re: Bair Hugger Forced Air Warming Products Liability Litigation	MDL No. 2666 (JNE/FLN)
This Document Relates to **ALL ACTIONS**	

DEFENDANTS' MEMORANDUM IN OPPOSITION TO PLAINTIFFS' MOTION TO EXCLUDE THE OPINIONS AND TESTIMONY OF GARY SETTLES, PH.D.

TABLE OF CONTENTS

INTRODUCTION

In moving to exclude the testimony of Professor Gary Settles, a leading expert in airflow visualization, Plaintiffs attempt to smokescreen their own failure to demonstrate that the Bair Hugger system negatively affects operating room airflow. As Defendants explained in their motion to exclude Plaintiffs' engineering experts, Plaintiffs have two general causation theories: the "reservoir of infection" theory, in which the Bair Hugger system supposedly blows bacteria on to the patient, and the "airflow disruption" theory, according to which heat from the warming blanket "destroys" the protective flow of air from the operating room ceiling. Plaintiffs' experts did not test either theory: they did not attempt to find bacteria in or around the Bair Hugger system, and they did not attempt to visualize the warming blanket's effects on airflow. Instead, they counted "particles" exiting the system, and built a computerized airflow simulation that is based on unverified and incorrect assumptions.

Prof. Settles is the world's foremost practitioner of the "Schlieren" optical technique. The Schlieren technique turns an invisible phenomenon—air movement—into a visible picture by capturing the refraction of light as it moves through air masses of varying temperature and density. Prof. Settles sought to test Plaintiffs' "airflow disruption" theory by visualizing the interaction of convection currents from the Bair Hugger blanket and the downward flow of air delivered by the supply vents over the operating room table. In his experiments, Prof. Settles showed that the large volume of air flowing from the ceiling "easily sweeps away" convection currents as they rise from the warming blanket.

Moreover, he showed that the "microjets" of warm air leaving the blanket rapidly dissipate into the ambient room air. Based on his experiments, Prof. Settles concludes that air from the Bair Hugger blanket lacks the power to *reach* the floor, much less "mobilise[] floor air into the surgical site area"[1] as Plaintiffs claim.

Prof. Settles faithfully applied to his experiments the same methodology that he has used for the past 50 years. He is abundantly qualified to render his opinions, which will help the jury understand Plaintiffs' evidence by elucidating the lack of support for their "airflow disruption" theory. Dr. Settles's opinions and testimony should therefore be admitted under Rule 702, *Daubert v. Merrell Dow Pharmaceuticals*, and *Goeb v. Tharaldson*, and Plaintiffs' motion to exclude them should be denied.

In addition to conducting his Schlieren experiments, Prof. Settles relied on his decades of experience as a fluid dynamicist to critique the reports of Plaintiffs' experts Said Elghobashi (who supplied the assumptions for Plaintiffs' computer model) and Daniel Koenigshofer (who offers opinions based on his experience as an HVAC engineer). These critiques fall well within Prof. Settles's domain as a rebuttal expert. *Aviva Sports, Inc. v. Fingerhut Direct Marketing, Inc.*, 829 F. Supp. 2d 802, 835 (D. Minn. 2011) (rebuttal expert's role is "to critique plaintiffs' expert's methodologies and point out potential flaws in the plaintiff's experts' reports."). His rebuttal opinions and testimony are relevant and reliable under *Daubert* and Rule 702, and they meet *Goeb v. Tharaldson*'s requirements

[1] McGovern P. et al., "Forced-air warming and ultra-clean ventilation do not mix: an investigation of theatre ventilation, patient warming and joint replacement infection in orthopaedics" 93 *J. Bone & Joint Surgery (Britain)* 1537 (2011), ECF. No. 829 at 2.

for general acceptance and foundational reliability. Plaintiffs' motion to bar his testimony must therefore be denied.

FACTS

The images produced by the Schlieren technique may appear futuristic, but the technique itself is centuries old. Prof. Settles details its history in his definitive treatise, *Schlieren and Shadowgraph Techniques: Visualizing Phenomena in Transparent Media*, Springer-Verlag (2001) (Excerpts at DX1).[2]

"Schlieren" imaging is not named after a person; rather, it takes its name from the German word for "streaks"—referring to the optical imperfections that lenses capture when light refracts through variations in air density. *Id.* at 7. The phenomenon was first documented by English philosopher and polymath Robert Hooke in the 17th Century, and the technique for capturing it was refined by a German scientist, August Toepler, in the 19th Century. *Id.* at 1–10. Ernst Mach used it to study shock waves, which led to the well-known "Mach number" for measuring supersonic speed. *Id.* at 10–11. In the 20th Century, Schlieren was used extensively to study the aerodynamics of rockets and aircraft—Werner Von Braun used it to develop the V-2 Rocket during World War II. *Id.* at 19. Contrary to Plaintiffs' suggestion that "very few engineers use [S]chlieren" anymore, it is still taught to undergraduates at CalTech.[3]

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[2] All Exhibits referred to herein are attached to the Declaration of Peter J. Goss filed concurrently.

[3] *See* http://shepherd.caltech.edu/T5/Ae104/Ae104b_handout2015.pdf (last visited September 26, 2017). The handout cites the "famous book by Settles," referring to *Schlieren and Shadowgraph Techniques*.

While the Schlieren technique has been primarily used in aerospace applications for much of the recent past, Prof. Settles pioneered its use to investigate human health concerns—most notably airborne disease transmission—in the 21st Century. In a now-famous photograph, Dr. Settles captured the full extent of the "thermal plume" resulting from a human cough:[4]

Dr. Settles performed this research with a virologist to study the effectiveness of respiratory masks in controlling the spread of H1N1 and other viruses. Their work was featured in the New England Journal of Medicine.[5] Prof. Settles also collaborated with a student to create the first computational simulation of the human thermal plume,[6] and has written extensively about it. Deposition of Prof. Gary Settles ("Settles Dep.") (DX2) at 342:132–5.

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[4] Grady D., "The Mysterious Cough, Caught on Film," *New York Times* (Oct. 27, 2008), http://www.nytimes.com/2008/10/28/science/28cough.html (last visited September 25, 2017).

[5] *See* Tang J. et al., "Coughing and Masks," 361 *New England J. Med.* e62 (2009), http://www.nejm.org/doi/full/10.1056/NEJMicm0904279 (last visited September 26, 2017).

[6] Craven B. et al., "A computational and experimental investigation of the human thermal plume," 128 *J. of Fluids Engineering* 1251 (2006).

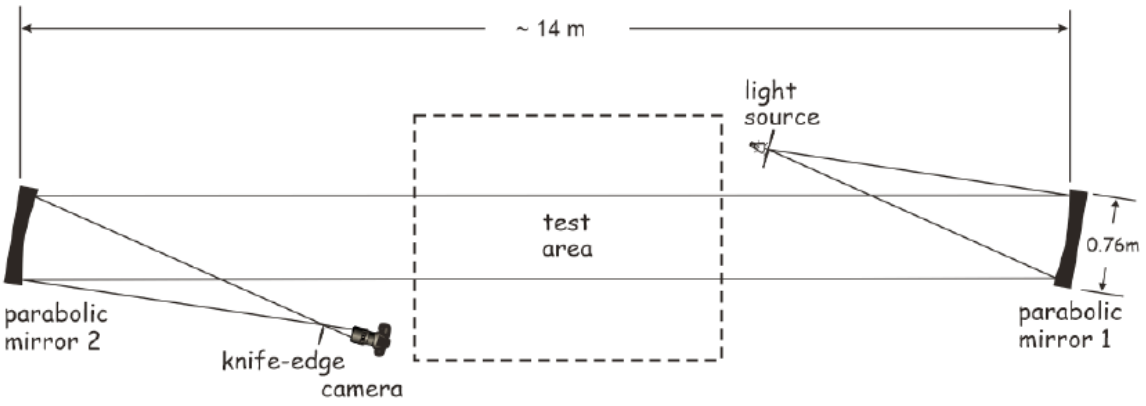
Prof. Settles's work in this case arises naturally from his research on the health implications of thermal plumes. He explains that his objective was to take the first Schlieren images of the interaction between a patient warming blanket and the "laminar downflow" typical of an operating room:

> The plan here was to use the [S]chlieren instrument, apparently for the first time, to observe the airflows associated with laminar downflow as -- such as would be in an operating room, and interacting with patient-warming blankets. And since other flow visualization methods had been used but not the schlieren technique, it was important to first get some evidence, get some images and video, and to try then from that evidence to understand the flow phenomenon that's happening.

Id. at 9:24–10:11.

The advantage of the Schlieren technique over other flow-visualization methods, such as the helium-filled bubbles that Mark Albrecht used for the McGovern, Legg, and Belani articles,[7] is that it does not introduce particles that distort the flow field with their own momentum and direction. Expert Report of Gary Settles, Ph.D. ("Settles Rpt.") (DX3) at 3. Schlieren imaging only requires a low-power LED light source to illuminate the test area, as seen in Prof. Settles's schematic for this project:

[7] Albrecht's "bubble experiments" are detailed in Defendants' motion to exclude Plaintiffs' engineering experts, ECF No. 805 at 12–16. The "bubble experiments" are one of the cornerstones of Plaintiffs' "airflow disruption" theory.



Id. at 5. According to Prof. Settles, the light from the LED is weaker than a flashlight beam, and "can have no possible effect upon the airflow patterns being studied." *Id.* By contrast, helium bubbles do not always follow airflow streamlines, and their inertia will distort airflow patterns depending on where and how they are introduced. *Id.* at 3. Only the Schlieren technique allows the researcher to observe airflow without disturbing it.

Taking Schlieren images with an adequate field of view poses logistical challenges, however. Visualizing an area just 30 inches in diameter requires two massive 30-inch parabolic telescope mirrors weighing hundreds of pounds each.[8] Needless to say, two mirrors of this size could not easily be moved into an orthopedic surgery suite. Moreover, the distance between the mirrors required to create the images—14 meters, or approximately 46 feet—is longer than most operating rooms can accommodate. Consequently, Prof. Settles conducted his experiments for this case in his own workspace,

[8] A 30-inch parabolic mirror from Boeing's Schlieren laboratory is depicted in Benne M., "A History and a Chronology of the PolySonic Wind Tunnel Schlieren and Window System," *44th AIAA Aerospace Sciences Meeting and Exhibit* (January 2006), http://highorder.berkeley.edu/proceedings/aiaa-annual-2006/paper0289.pdf (last visited September 26, 2017) at 6.

and built the components he needed in order to study the interaction of the warming blanket and the mass airflow from the ceiling.[9]

The most important component for the experiments was the downflow generator, which Prof. Settles carefully designed to match the flow rate of a typical operating room air supply system. Settles notes that the flow rate plays an important role in controlling airborne contaminants, "because it is the speed of the downflow that directly counteracts the buoyant rise of thermal currents from people, equipment, patient-warming blankets, etc." *Id.* at 6. Although the downflow is designed to disperse contaminated particles, if the speed is too high, "it can suppress the natural thermal plume rising from the surgical site and impinge contaminants upon the patient and upon the surgical wound." *Id.* The literature therefore generally recommends a speed in the range of 30 feet per second: fast enough to disperse contaminants away from the surgical field, but not so fast that it blows them into the patient's protective heat envelope. *See id.*

The velocity that Plaintiffs used for their computer model was 38 feet per minute, so Prof. Settles set that as his target. *Id.* While there was some variation in the speed of the air emerging from Prof. Settles's downflow generator across its length and width, these small velocity differences will average out over distance and do not affect the Schlieren

[9] Prof. Settles's report also demonstrates "proof-of-concept" for another technique, "Background-Oriented Schlieren," that does not require large parabolic mirrors and is therefore more amenable to conducting flow-visualization experiments in an operating room. Settles Rpt. (DX 3) at 17–18. Prof. Settles accordingly reserved the right to conduct future experiments in an operating room, such as the operating rooms at issue in upcoming bellwether trials. In the event he proceeds with those experiments, Prof. Settles will provide a case-specific expert report in accordance with the deadlines provided by the Court.

images. Settles Dep. (DX2) at 242:2–243:8. The effectiveness of the downflow in suppressing a hot thermal plume can be seen in its impact on the plume of a candle flame:

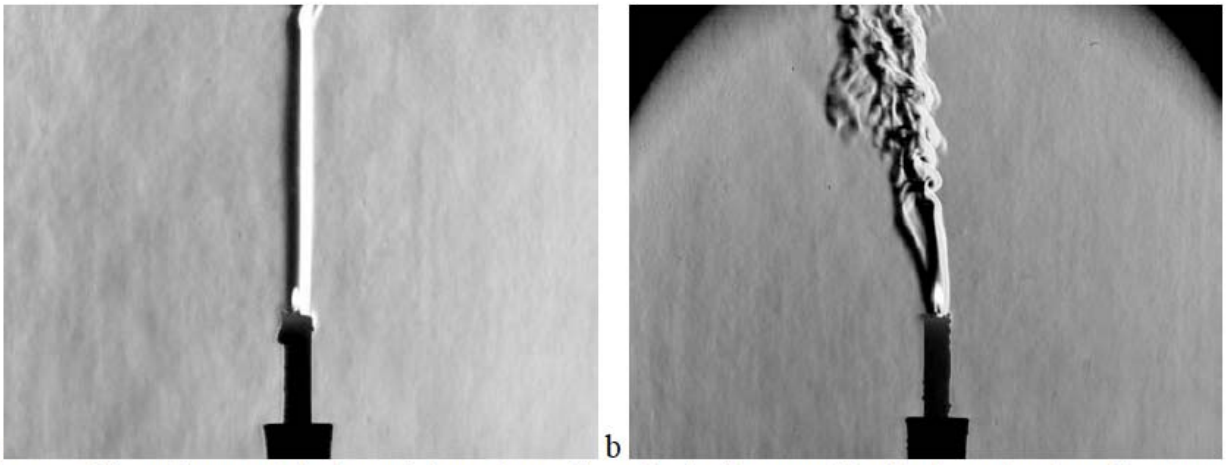


Fig. 4 - Schlieren images of the thermal plume from a lit candle a) without and b) with the 38 fpm downflow from the downflow generator. Corresponding videos are DSC_0107 and DSC_0051, respectively.

Settles Rpt. (DX3) at 7. Given the downflow generator's ability to disrupt the hot plume from a burning candle, Prof. Settles was not surprised to observe that it easily swept away the much cooler air currents that rise from patient warming blankets. He found that the Bair Hugger system and Dr. Scott Augustine's HotDog device both generated convection currents, but in each case the currents "struggle[d] to buck the downflow and generally fail[ed] to do so." *Id.* at 11.[10]

Prof. Settles also measured the temperature of the air exiting the Bair Hugger blanket at various points to assess its potential for generating powerful warm-air currents as alleged by Plaintiffs and their experts. With the Bair Hugger unit set at 43˚C (109˚F), Prof. Settles found that the air temperature just outside one of the blanket's microholes was

[10] Prof. Settles took Schlieren videos for both the Bair Hugger and HotDog experiments. *See id.* at 12. These videos can be shown at oral argument if the Court deems it appropriate and helpful.

only in the mid-30s (around 90˚F). *See id.* at 11 (Fig. 9). A couple of inches from the blanket's surface, the air temperature dropped to within 1˚C of room temperature (approximately 22˚C, or 72˚F). *Id.* at 10. This significant temperature drop demonstrates that the Bair Hugger system quickly and efficiently distributes warm air across a large area (approximately one square meter), which then rapidly mixes into the ambient room air. *See id.* at 9.

Prof. Settles likewise did not find any jets of hot air emerging from the Bair Hugger blanket when he took temperature measurements around his mock surgical table. The highest temperature he found at the head and neck of the mannequin—where most of the air from the blanket is released—was 24˚C (75˚F), and the highest temperature he recorded anywhere was 28˚C (82˚F). *Id.* at 11, 13-14. At no point did Prof. Settles find a temperature that even approached 41˚C (106˚F)—the temperature that Plaintiffs' expert Prof. Said Elghobashi assumed as a "boundary condition" for Plaintiffs' computer model. *Id.* at 18–19. As Defendants explain in their motion to exclude Plaintiffs' engineering experts, Prof. Elghobashi's use of an unrealistically high temperature caused Plaintiffs' computer model to exaggerate the turbulence intensity in the room. *See* ECF No. 805 at 38–39.

Based on the results of his Schlieren experiments, his temperature measurements, and a review of the relevant scientific and medical literature, Prof. Settles found flaws in the opinions of Plaintiffs' "airflow disruption" experts. With respect to Mr. Koenigshofer's opinion that "[a]ir leaving the blanket at 100-110F will cause upward convective flow," Settles points out that Koenigshofer significantly overstated the temperature of the air

leaving the blanket. Settles Rpt. (DX3) at 20. He further notes that Koenigshofer has not conducted any experiments to support his opinion that the Bair Hugger system "will create turbulence at the floor, stirring settled particles." *Id.* at 19. As for Prof. Elghobashi, his failure to validate the results of Plaintiffs' computer model with an experiment renders his opinions "automatically suspect in the fluid dynamics community." *Id.* at 18. Settles notes that Prof. Elghobashi "overlook[ed] the obvious step of making some measurements, *it could be simple measurements*, in an operating room for a direct CFD experiment comparison."[11] Settles Dep. (DX2) at 115:24–116:12 (emphasis added). Had Elghobashi done so, he would have found (as Settles did) that the temperature of the air exiting the surgical drapes is nowhere near 41˚C. Because Prof. Elghobashi's assumed boundary condition is not just unvalidated but actually invalid, Plaintiffs' computer model "solve[s] a different problem than the one at hand." *See id.* at 101:11–22. In Prof. Settles's view, this "completely invalidates Prof. Elghobashi's stated conclusions." Settles Rpt. (DX3) at 19.

ARGUMENT

If this were a typical case, Plaintiffs' experts would have conducted an airflow experiment, and Defendants' experts would then critique it. *See In re Mirena IUD Prods. Liab. Litig.*, 169 F. Supp. 3d 396, 418–19 (S.D.N.Y. 2016) ("[G]iven that Defendants' experts are attempting to prove a negative . . . pointing to the absence of convincing studies

[11] As discussed in Defendants' motion to exclude Plaintiffs' engineering experts, Prof. Elghobashi measured the length of the surgical drapes of a mock-up in a Santa Monica operating room, but he did not measure the temperature or velocity of the air escaping from them. *See* ECF No. 805 at 38–40.

or the weaknesses of studies on which Plaintiffs rely, and evaluating them in light of their own . . . experience, training and research, is in these circumstances a logical and valid approach.") (citing *McCullock v. H.B. Fuller Co.*, 61 F.3d 1038, 1042–43 (2d Cir. 1995). But Plaintiffs' experts have no airflow experiment—instead, Professor Elghobashi simply plugged assumptions into a software program without taking real-world measurements to verify them. Thus, Defendants find themselves in the somewhat unusual position of defending Prof. Settles' airflow experiments, without having any experiments from Plaintiffs to critique.

Regardless, Prof. Settles rigorously applied a technique that he has refined over the past several decades. He has assiduously "employ[ed] the same level of intellectual rigor" that characterizes his academic research. *See Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137, 152 (1999). Moreover, his work in this case was not solely "developed for litigation," but rather is a natural extension of his research into the human thermal plume. *See Lauzon v. Senco Prods., Inc.*, 270 F.3d 681, 687 (8th Cir. 2001). Plaintiffs' motion to exclude Prof. Settles's opinions and testimony should therefore be denied.

I. PROF. SETTLES IS WELL QUALIFIED TO RENDER OPINIONS BASED ON THE SCHLIEREN TECHNIQUE.

Over the past half-century, no one has accumulated more expertise with the Schlieren technique or contributed more to its advancement than Gary Settles. He is *the* Schlieren expert; he literally wrote the book on the subject. Settles Dep. (DX2) at 94:4–5 ("Q. Do you know how 3M found you? A. I'm the [S]chlieren expert"); *see also* DX1.

Prof. Settles's qualifications to perform and draw inferences from Schlieren experiments are unassailable.

Plaintiffs' attack on Prof. Settles's qualifications betrays a misunderstanding of his work and his role in this case. Dr. Settles is an expert in *experimental* fluid dynamics, not computational fluid dynamics (CFD). *Id.* at 38:23–39:6, 85:17–20. In other words, he doesn't build computer models, he conducts *live experiments*. Thus, Plaintiffs aim thier complaint that he is not an expert in *computational* fluid dynamics at the wrong expert—3M has retained Prof. John Abraham to address all things CFD. That said, Prof. Settles is qualified to critique Prof. Elghobashi's flawed boundary conditions, even though he is not a CFD expert. All he had to do to refute Elghobashi's key assumption was take some simple temperature measurements, and observe that the tiny jets of air from the Bair Hugger blanket only go a couple of inches before mixing completely with the ambient air.

Likewise, the fact that Prof. Settles is not a "particle expert" does not disqualify him from testifying about particle-laden thermal plumes. Indeed, Plaintiffs *agree* with Settles that "[s]quames are likely to be found in areas of air recirculation, and there is a high potential such squames can be deposited into a surgical site." Pl. Mem. at 7. Settles is therefore indisputably qualified to testify that "dead zones" created by obstacles in the downflow, such as surgical lamps and surgical staff, are far more likely to drop particles into the surgical site than convection currents from the Bair Hugger system. *See* Settles Rpt. (DX3) at 15–16. Lastly, based on his expertise with the human thermal plume and his direct observations from these experiments, Prof. Settles is amply qualified to testify that convection currents from warming blankets are likely to help *protect* the wound from

particles by increasing the patient's heat envelope. *See id.* at 11–12. In sum, the Court should disregard Plaintiffs' misplaced attack on Prof. Settles's qualifications.[12]

II. PROF. SETTLES SCRUPULOUSLY APPLIED THE SCHLIEREN TECHNIQUE IN HIS EXPERIMENTS FOR THIS CASE.

Plaintiffs' many criticisms of Prof. Settles's methodology amount to no more than quibbles. "A litigant's mere disagreement with [an] expert's assumptions and methodology does not support exclusion of the expert's testimony." *Wood v. Robert Bosch Tool Corp.*, No. 4:13cc01888 TCM, 2015 WL 5638035, at *10 (E.D. Mo. Sept. 24, 2015) (citing *David E. Watson, P.C. v. U.S.*, 668 F.3d 1008, 1015 (8th Cir. 2011). "'Attacks on the foundation' of the expert's opinion and conclusions, and the completeness of the expert's methodology, go to the weight rather than the admissibility of the expert's testimony." *Id.* (citing *Sphere Drake Ins. PLC v. Trisko*, 226 F.3d 951, 955 (8th Cir. 2000)). The Court should disregard Plaintiffs' disagreements with the materials and methods that Prof. Settles used for his experiments.

A. Plaintiffs' Criticism that the Experiments Were Not Done in an Operating Room Misses the Point.

As noted, Prof. Settles's experiments could not feasibly have been conducted in an operating room. Plaintiffs nevertheless argue that he should have recreated every detail of an operating room in his warehouse space. But as Prof. Settles explains, his goal was not

[12] Curiously, Plaintiffs also suggest that Prof. Settles will "oppose plaintiffs' experts on filtration" (Pl. Mem. at 4), but he offers no opinions on that topic. More to the point, Plaintiffs *have no* experts on filtration. Their HVAC expert, Dan Koenigshofer, disqualified himself from rendering opinions on filter efficiency. *See* Defts.' Motion to Exclude Plaintiffs Engineering Experts (ECF No. 805) at 26-27.

to develop "a complete simulation of an operating room," but rather "to isolate the laminar downflow, the surgical table, the mannequin with the blankets and examine the interaction of downflow and blankets in the same way between the forced air and the conduction blanket[.]" Settles Dep. (DX2) at 302:12–25. If anything, by performing the experiments in an open warehouse instead of an operating room, Settles *increased* the likelihood of disruptions to the laminar flow, since the warehouse had no return vents to draw away convection currents. Nevertheless, Prof. Settles's purpose was to visualize what happens when heat from a warming blanket meets a typical operating room downflow, and that is what he did. To argue that he and his team should have worn "space suits" and surgical gloves in the experiments, Pl. Mem. at 16, is to strain at a gnat.

Plaintiffs' other criticisms of Settles's experiments are similarly picayune and inconsequential. For example, they fault him for not ensuring his Bair Hugger unit was "calibrated," Pl. Mem. at 18, but the device was brand-new. Settles Dep. (DX2) at 143:14–24. There is no evidence that Plaintiffs' experts Michael Buck and Yadin David calibrated their Bair Hugger units before conducting their investigations, even though their units were "pre-owned" (David's was purchased from eBay). Similarly, they argue that Prof. Settles should have used an "authentic OR overhead lamp," or at least disclosed the wattage of the lamp he used. Pl. Mem. at 17. But the purpose of the images taken with the lamp was to demonstrate the lamp shield's effects as an *obstacle to the downflow*, and not as a heat source. *See* Settles Rpt. (DX3) at 16 (Fig. 15d). Irrespective of the lamp's wattage, Prof. Settles showed that its 19-inch diameter—approximately the size of the lamps modeled in Plaintiffs' computer simulation—"creates a 'dead zone' in the laminar downflow," which

is a much more plausible pathway for airborne contamination than the Bair Hugger system. *See id.* at 16–17.

Finally, the fact that Schlieren imaging tracks air currents and not particles does not make it somehow incapable of illuminating where particles can go. Plaintiffs' entire case is premised on the notion that contaminated particles travel on thermal currents. By arguing that Schlieren imaging is irrelevant to particle travel, Plaintiffs would invalidate all of the flow visualization experiments on which their experts rely, including most prominently the helium bubble demonstrations reported in the McGovern (2011), Legg (2013), and Belani (2013) papers.

B. Prof. Settles Made Sure His Opinions Were Backed by Reliable Evidence.

Plaintiffs contend that "Settles'[s] conclusions are unsupported," Pl. Mem. at 20, but in fact he verified that each of his opinions is supported by his experimental results. To prepare for his deposition, he reviewed his laboratory notebook to confirm that his June 1, 2017 Report accurately described the experiments. He found two discrepancies. First, he had slightly overstated the precision of the downflow generator: although his target range was ±10%, the actual range was closer to 30%. Settles Dep. (DX2) at 173:2–14. Second, he found a comment in the lab notebook suggesting that the downflow generator was not on (although he had assumed that it was) when he took Schlieren images near the simulated operating room floor. *Id.* at 268:3–11. Immediately upon discovering these issues, Prof. Settles submitted a revised Report providing the true precision of the downflow velocity, and withdrawing his opinion that he "observe[d] little air motion near

the floor of a simulated OR with schlieren optics."[13] *See id.* The fact that Prof. Settles corrected himself on these relatively minor points demonstrates his faithfulness to the experimental data—a hallmark of sound scientific reasoning.

C. Prof. Settles Did Not Rely on 3M to Design His Experiments or Supply Published Literature.

Plaintiffs allege that Prof. Settles was "spoon-fed by counsel," "relied entirely on defense counsel to establish the conditions under which he took these pictures," and "apparently relied entirely on defense counsel to validate the experimental design." Pl. Mem. at 16, 18. These charges are totally spurious. Defense counsel made a cameo in one of the videos, as Prof. Settles explains:

> Q. Okay. Was there anyone at 3M present during any of the testing, or the attorneys?
>
> A. Attorney Goss and his assistant were present for part of one day of testing.
>
> * * *
>
> Q. . . . Did they assist in any way?
>
> A. Yes.
>
> Q. How did they assist?
>
> A. Peter Goss got on the operating table and we took a schlieren image of him.
>
> Q. Just laying down on the operating room table?
>
> A. That's right, no draping or anything.
>
> Q. Why?

[13] Plaintiffs did not attach the revised report to their motion to exclude Dr. Settles. Compare Plaintiffs' Exhibit A (ECF No. 834-1) at 21, which contains eight opinions, with DX 3 at the same page, where the fifth opinion (concerning the lack of air movement near the floor) is removed. In addition, see DX 3 at 6, which discloses that the downflow generator delivered an average of 39 feet per minute with a standard deviation of 12 feet per minute (approximately a 30% range).

> A. The idea was to see the heat transfer, convective heat transfer from the human body using the schlieren imaging.

Settles Dep. (DX2) at 53:7–54:3. Other than this "live volunteer" episode, 3M's lawyers had no involvement in the experiments. *See id.* at 182:1–5. It is absurd for Plaintiffs to claim that 3M and its lawyers somehow "spoon fed" the experiments to Prof. Settles. Similarly, Prof. Settles did not rely on 3M to supply the relevant literature; according to him, "[I]t's up to me to go find the literature. If I didn't have the Sessler report and some other literature I consider [that] a flaw in my literature search. I wasn't depending on 3M or their legal team to provide me with the sets of references." *Id.* at 155:23–156:7. In this manner he applied "the same level of intellectual rigor" to this project that he would use in any of his research. *Kumho*, 526 U.S. at 152. His testimony and opinions should therefore be allowed.

III. PROF. SETTLES'S BAIR HUGGER/HOTDOG COMPARISON IS DIRECTLY RELEVANT TO THE ISSUES IN THIS CASE.

Plaintiffs argue that Prof. Settles's experimental comparison of the HotDog to the Bair Hugger system—which showed that the downflow from the ceiling easily disperses convection currents from both devices—should be excluded because "[t]here are no references to HotDog in any of Plaintiffs' expert reports." Pl. Mem. at 24. This is only true if one ignores Plaintiffs' experts' reference lists, which are replete with articles comparing the HotDog to the Bair Hugger system. If Prof. Settles's comparison of the two devices is irrelevant, then so are the Legg, Belani, and McGovern studies. Indeed, the whole premise of Plaintiffs' general causation case is McGovern's comparison of infection

rates between Bair Hugger and HotDog. Prof. Settles's comparison of the devices' thermal characteristics is therefore entirely relevant and should be admitted.

IV. PROF. SETTLES'S OPINIONS AND TESTIMONY MEET THE REQUIREMENTS OF *FRYE-MACK*.

In addition to meeting the Federal Rules' threshold for admissibility, Prof. Settles's opinions and testimony also satisfy Minnesota Rule 702 and the *Frye-Mack* standard as expressed in *Goeb v. Tharaldson*, 615 N.W.2d 800, 814 (Minn. 2000). Prof. Settles's experiments comply with the Schlieren methods detailed in his treatise; his testimony and opinions are therefore both "foundationally reliable" and "generally accepted" in the flow-visualization community. *Goeb*, 615 N.W.2d at 814. Further, Minnesota law agrees with this Court that "[t]he function of rebuttal testimony is to explain, repel, counteract or disprove evidence of the adverse party." *Signature Flight Support Corp. v. Cty. of Ramsey*, No. 62-CV-14-3089, 2017 WL 1377751, *1 (Minn. Tax Apr. 7, 2017) (quoting *Aviva Sports, Inc. v. Fingerhut Direct Mktg., Inc.*, 829 F. Supp. 2d 802, 834 (D. Minn. 2011)); *accord Whitney v. Buttrick*, 376 N.W.2d 274, 278 (Minn. App. 1985) (granting new trial based on district court's improper exclusion of rebuttal expert testimony). Thus, it is entirely appropriate for Prof. Settles to critique Plaintiffs' experts' opinions, and he should be permitted to do so at trial in Ramsey County as well as in this Court.

CONCLUSION

Prof. Settles's opinions are rooted in methodologically sound experiments and a half-century of expertise applying the Schlieren technique. Through his images, he will help the jury understand, evaluate, and repudiate Plaintiffs' argument that the Bair Hugger

system increases surgical infection risk by disrupting operating room airflow. His opinions and testimony should therefore be permitted, and Plaintiffs' motion to exclude be denied, under Rules 702 and 703, *Daubert*, and *Goeb v. Tharaldson*.

Dated: October 3, 2017

Respectfully submitted,

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